

**MODULE NUMBER 5
OF
INSTRUCTION GUIDE NUMBER 40**

**ON-THE-JOB TRAINING
FOR THE
SAND, GRAVEL, AND CRUSHED STONE INDUSTRY**

MAINTAINING CONVEYOR SYSTEMS



For the job of conveyor operation and maintenance, this module describes the basic job steps, potential accidents and hazards, and recommended safe job procedures.

This job is usually done by the plant operator and maintenance personnel, but it may be done by other occupations, such as utility worker, laborer, etc. The plant operator and maintenance personnel must make sure that employees, and others, are protected from accidents and injuries resulting from conveyor maintenance.

Conveyor systems used at sand, gravel, and crushed stone operations are very similar, although the systems are built by many different manufacturers. Each conveyor system has its own performance requirements, design features, and operating environment. These special situations have to be considered in order to establish safe and efficient

operating and maintenance procedures. Conveyor manufacturers can often assist in developing these procedures.

Many conveyor systems perform well with as few as one or two operators. Conveyor performance can be continuously monitored by electrical controls, safety sensors, closed circuit television, signal systems, and other devices.

Modern electrical controls use programmable controllers, or computers, to measure conveyor belt performance. Electrical controls can also be used to weigh, mix, and blend material, as well as to switch material flow paths. Sensors, and other devices used to indicate maintenance requirements and other unsafe conditions, are integral parts of some electrical control systems. These controls, sensors, and other devices are highly durable. Typically, they can only be maintained and serviced by specialists.

CONVEYOR ACCIDENTS AND DAMAGE PREVENTION

INTRODUCTION

Conveyor accidents that cause personal injuries do not normally occur because of faulty equipment design or component failure. These accidents are usually caused by human error, inadequate training, or lack of hazard awareness.

Employees should receive safety training, after the conveyor is designed and the system is installed by qualified personnel. Supervisory, operating, and maintenance personnel should be instructed in safe operating procedures, hazard recognition, and housekeeping skills. Periodic refresher training should be given in these subjects. Unauthorized employees should not be permitted to enter hazardous areas.

All workers - especially maintenance personnel - should be provided with proper tools and equipment to operate, and maintain, the conveyor in a safe condition.

COMMON ACCIDENTS

One common type of accident involving conveyors occurs when an employee stops a conveyor to perform work on it, but does not properly lockout and tag the electrical controls. Another employee, noticing that the belt is stopped, restarts it - injuring the employee that is performing the work.

Another common accident involving conveyors occurs when an employee becomes caught in unguarded, or inadequately guarded, moving equipment. The guards may not have been installed, or, more commonly, the guards may have been removed to perform work. Also, the guards may have been previously removed and not replaced. Employees should be sure that equipment guards are properly installed and maintained.

DAMAGE PREVENTION

The belt is the most expensive item in a conveyor system. Therefore, proper belt operation, and belt maintenance, are particularly important in order to minimize repair and replacement costs.

Weather can affect belt operation. In sub-zero temperatures, special lubricants are sometimes necessary in order to avoid overloading the drive motor. The belt may sometimes be covered with moisture, frost, or frozen material. A belt scraper, installed just ahead of the point where the belt goes onto the drive pulley, may be useful for removing frost, or frozen material, that is stuck to the belt. Operating the belt for a brief period, at start-up, before loading it, may be advisable, in order to remove frost or frozen material.

Sticky or frozen material on pulleys or idlers can cause belt misalignment, or other damage. Pulley scrapers, and/or soft rubber pulley lagging, may help to correct this condition. No one should be allowed to remove stuck material from the belt, unless the belt is stopped and the master electrical control is locked out and tagged.

Belts can be damaged, or prematurely worn, if loaded with improper sizes or volumes of material. Foreign objects, such as tramp iron, spikes, or timbers, in the material flow can jam the belt, causing expensive shut-downs and repairs.

Stuck idlers, under a high speed belt, can wear through to a knife edge that can severely damage a belt. Plant operators should be alert for impending idler failures, and correct malfunctions before the belt is damaged.

SAFETY PRECAUTIONS

The following safety precautions are generally applicable to conveyor systems:

1. Conveyors should only be used to handle material for which they were designed.
2. Belt capacity, and belt speed design ratings, should not be exceeded.
3. Only trained personnel should be allowed to operate conveyor systems. Operators should have complete knowledge of conveyor operation, electrical controls, safety devices, and warning devices, and the capacity and performance limitation of the conveyor system.
4. All personnel should know the location and operation of all emergency controls and safety devices. Areas near emergency controls and safety devices must be kept free of obstructions at all times.

5. All equipment must be inspected at the beginning of the shift, before the equipment is started. Guards, safety devices, and warning signs should be maintained in proper positions and in good working order. Only competent and properly trained and authorized persons should adjust and repair safety devices.
6. Another "walk-through" inspection should be made after the plant is started, in order to detect any problems with idlers, pulleys, shafts, bearings, drives, bolts, or belt splices. Listen for unusual sounds.
7. Poking at, or prodding, material on the belt, or any component of a moving belt, must be prohibited.
8. Contact with, or work on, a conveyor must occur only while the equipment is stopped, and the electrical control is properly locked out and tagged out.
9. People must not ride on, step on, or cross over a moving conveyor, except at designed cross-overs.
10. People should only walk, or climb, on conveyor structures by using the walkways, stairs, ladders, and cross-overs that are provided.
11. Good housekeeping is a prerequisite for safe conditions. All areas around a conveyor, particularly those areas around drives, walkways, safety devices, and control stations, should be kept free of debris or any other obstacles. Any posted warning signs or instructions should be kept current.
12. Conveyors that are in an unsafe condition for operation, or that do not have all guards and safety devices in good condition, must not be used until all necessary repairs have been made.
13. All people should be barred, by appropriate means, from entering an area where falling material may present a hazard. Warning signs and barricades can be used.
14. First-class maintenance is a prerequisite for the safest conveyor operation. Maintenance, including lubrication, must be performed with the conveyor power locked-out and tagged. Special lubricating equipment, lube extensions, pipes, etc., can be installed so that lubrication of an operating conveyor can be done without any hazards.

CONVEYOR SYSTEM MAINTENANCE

An equipment maintenance program includes the tasks of inspection, housekeeping, lubrication, and repair.

During inspections, check the alignment of all mechanical components, and the operating alignment of the belt on carrying and return idlers. Make sure there are no repair or construction materials, tools, or projecting members that can rub, tear, or cut the belt when it starts up. Check that chute skirtboards are intact, and are not touching the belt. Adjust rubber edging strips on skirtboards so that the strips touch only lightly on the belt surface. Check and adjust belt scrapers, if necessary.

Good housekeeping is essential for dependable operation and low cost maintenance. Built-up material on the deck can rub against, and eventually stop, idlers, thereby increasing belt tension and possibly damaging the belt. Spillage on the return belt can also damage the belt, as lumps of material are squeezed between the belt and pulleys. Scrapers on the return belt, where the belt enters the tail pulley, may be desirable in some cases.

A comprehensive lubrication program is essential for low maintenance costs and dependable conveyor operation. Pay particular attention to the lubrication of all bearings. Equipment life will be extended by following the manufacturer's recommendations for the type of lubricant, amount and frequency of application, and type of greasing equipment to be used.

Frequently used repair parts should be stocked at the plant site, in order to maximize plant dependability and productivity and minimize maintenance costs and downtime.

The remainder of this module covers safe job procedures for seven conveyor maintenance tasks. Following these procedures will help to minimize incidents which can cause injuries, and adversely affect production.

REQUIRED AND/OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:
HARD HAT, STEEL-TOED SHOES, GLOVES, SAFETY GLASSES WITH SIDE SHIELDS, OR GOGGLES, HEARING PROTECTION.

I. LACING CONVEYOR BELTS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. De-energize and lockout and tag belt power. Mechanically block belt from rolling without power.	1. A) Electrical hazard - face of breaker coming open and allowing contact with energized parts. B) Mechanical hazard - power turned on due to improper lock-out procedure while working on equipment.	1. A) Stand on non-conductive mat. Wear gloves. B) Never work on equipment unless you have locked-out power. Each person doing work must lockout and tag. Each person must keep their key in their possession. Confirm that proper equipment was locked-out by testing start switch.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
<p>2. Select tools and supplies:</p> <ol style="list-style-type: none"> 1. Two come-alongs 2. Impact wrench 3. Hole punch 4. Two belt clamps 5. Utility knife 6. Straight edge 7. 5'x2"x10" board 8. Template 9. Nails 10. Stud breaker 11. Laces 	<p>2. A) Strains from lifting tools.</p> <p>B) Cuts from handling cable.</p> <p>C) Cuts from utility knife.</p>	<p>2. A) Use proper bending and lifting technique by using knees and legs rather than back.</p> <p>B) Wear gloves, and watch for broken wires in cable.</p> <p>C) Wear protective gloves, and make sure knife is properly sheathed.</p>
<p>3. Check/inspect tools and workplace. Ensure that counterweight is immobilized.</p>	<p>3. A) Injury due to cable or chain break.</p>	<p>3. A) Inspect cable or chain. Repair/report if damaged.</p>

**SEQUENCE OF
BASIC JOB STEPS**

**POTENTIAL ACCIDENTS
OR HAZARDS**

**RECOMMENDED SAFE JOB
PROCEDURES**

	B) Shock from electrical impact wrench.	B) Inspect impact wrench for damage and wear on case and insulation of wires. Inspect impact wrench for three prong plug, or other means of grounding, or a double insulated case. Dry damp equipment - clean greasy equipment. Do not stand in water or on damp surfaces if possible - wear rubber boots if needed.
	C) Slips/falls.	C) Remove slipping/tripping hazards.
4. Attach belt clamps to each end of belt about 3 feet back from place to be spliced. Insert belt between the clamps, and tighten bolts.	4. A) Falling off conveyor belt to ground.	A) Use approved manlift if necessary for safe access. You must use fall protection if you are working in an elevated, exposed position.
	B) Pinched fingers.	B) Keep fingers clear of pinch points.
5. Attach both come-alongs to belt clamps, using two holes in each clamp.	5. A) Cuts or scratches due to burrs or broken strands.	5. A) Inspect cables. Wear gloves, and do not slide hands along cable.

**SEQUENCE OF
BASIC JOB STEPS**

**POTENTIAL ACCIDENTS
OR HAZARDS**

**RECOMMENDED SAFE JOB
PROCEDURES**

6. Use the straight edge and utility knife to cut the torn edge away.

6. A) Cuts.

6. A) Use a retractable blade knife. Cut away from, or beside, your body - never cut toward yourself. Keep a firm grip on tools. Do not try to cut through belt with only one cut - make several cuts until knife goes through. Use sharp blades.

B) Knife dropped on people below.

B) Place warning barricade below.

7. Draw two edges together with come-along, checking progress periodically, to obtain desired tension.

7. A) Cable or chain breaking.

7. A) Stand to the side and face away from come-along while operating the handle. If conveyor does not have gravity, or other type, take-up pulley, loosen tail pulley, and pull forward as much as necessary.

**SEQUENCE OF
BASIC JOB STEPS**

**POTENTIAL ACCIDENTS
OR HAZARDS**

**RECOMMENDED SAFE JOB
PROCEDURES**

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| <p>8. Splice belt.</p> <ol style="list-style-type: none">1. Slide the 5' - 2x10 board under splicer.2. Set template on top of belt and drive the 6 penny nails through board.3. Connect hole punch to impact wrench.4. Drill out all holes.5. Remove nails and template.6. Insert bolts.7. Tighten bolts from middle to each outside edge, to prevent buckle.8. Break off excess stud length by bending studs parallel to belt with stud breaker. | <p>8. A) Falling off conveyor.</p> | <p>8. A) You must use fall protection when working from elevated positions.</p> |
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SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. Loosen come-alongs, and remove.	9. A) Struck by handle.	9. A) Grip handle firmly, flip safety latch to reverse, and stroke handle full stroke in both directions.
10. Remove clamps.	10. A) Fall off conveyor.	A) You must use fall protection if you are working in an elevated, exposed position.
	B) Bruised knuckles.	B) Wear gloves, and grip tools firmly.
11. Realign and tension tail pulley, if previously loosened.	11. A) Cut knuckles.	11. A) Wear gloves. Keep firm grip on tools.
12. Remove any mechanical blocks. Remove your lock-out and tag. Restore power.	12. A) Persons caught in conveyor.	12. A) Check that everyone is clear of equipment.

II. CHANGING BEARINGS ON CONVEYORS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
<p>1. Lockout and tag belt power.</p>	<p>1. A) Electrical hazard - face of breaker coming open and allowing contact with energized parts.</p> <p>B) Mechanical hazard - power turned on due to improper lock-out procedure while working on equipment.</p>	<p>1. A) Stand on non-conductive mat. Wear gloves.</p> <p>B) Never work on equipment unless you have locked-out power. Each person doing work must lockout and tag. Each person must keep their key in their possession. Confirm that proper equipment was locked-out by testing start switch.</p>
<p>2. Select tools and supplies:</p> <ol style="list-style-type: none"> 1. Ratchet and sockets 2. A come-along 3. Replacement bearing 4. Burlap bag and hammer 5. Cutting torch 6. Emery cloth 7. Grease 	<p>2. A) Strains from lifting tools.</p> <p>B) Cuts from handling come-along cable.</p>	<p>2. A) Use proper bending and lifting technique by using knees and legs rather than back.</p> <p>B) Wear gloves, and watch for broken wires in cable.</p>

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Check/inspect tools and workplace.	3. A) Slipping/tripping hazards. B) Come-along cable or chain break, injuring personnel. C) Cutting/welding hazards. D) Fire.	3. A) Remove, if possible, or avoid. B) Inspect cable or chain - repair or replace if defective. C) Make sure that hoses, gauges, and regulators are in good condition, and kept clean, and that cylinders are secured, and valves and gauges are protected. D) Keep work area clear of combustible materials. Keep fire extinguisher available.
4. Remove guard. Hold guard securely if it could fall when disconnected. Get help when removing very large guards.	4. A) Cuts; bruised knuckles. B) Tripping; foot injury.	4. A) Use proper tools in the proper manner. Wear gloves. B) Place guard, bolts, etc., out of the way
5. Attach come-along to shaft behind bearing, and to support frame.	5. A) Cable breaking. B) Cuts due to burrs on cable.	5. A) Inspect cable. Repair/report if damaged. B) Wear gloves. Do not slide hand along cable.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Loosen the bearing by removing bolts.	6. A) Bruised knuckles.	6. A) Use tools properly.
7. Take up slack to relieve pressure on bearing.	7. A) Cable breaking.	7. A) Stand to the side, and face away from come-along while operating the handle.
8. Remove bearing.	8. A) Metal in eyes. Piece of metal in hand.	8. A) If bearing is frozen, wear goggles and gloves, and cover the bearing with a burlap bag (or something similar). Knock housing away from race with a hammer.
	B) Hazards with cutting torch, if bearing must be cut away from shaft.	B) Wear goggles or face shield. Check that tanks are secure, and equipment is in good working order. Check that work area is clear of extraneous combustible material, and that fire extinguisher is available.
9. Install new bearing. Buff shaft with emery cloth. Grease shaft lightly. Line up bearing with come-along.	9. A) Cuts, bruised knuckles.	9. A) Wear gloves. Use proper tools in proper manner.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
10. Restore power.	10. A) Person caught in conveyor.	10. A) Make sure people are clear of belt. Remove lock and tag from switch.

III. REPLACING "V" BELTS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Lockout and tag belt power.	1. A) Electrical hazard - face of breaker coming open and allowing contact with energized parts. B) Mechanical hazard - power turned on due to improper lock-out procedure while working on equipment.	1. A) Stand on non-conductive mat. Wear gloves. B) Never work on equipment unless you have locked-out power. Each person doing work must lockout and tag. Each person must keep their key in their possession. Confirm that proper equipment was locked-out by testing start switch.
2. Remove guard. Hold guard securely if it could fall when disconnected. Get help when removing very large guards.	2. A) Cuts; bruised knuckles. B) Tripping; foot injury.	2. A) Use proper tools in the proper manner. Wear gloves. B) Place guard, bolts, etc., out of the way.
3. Loosen the adjustments.	3. A) Wrench slipping off and injuring hand.	3. A) Use proper tools in the proper manner.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Remove old belts.	4. A) Pinched finger.	4. A) If necessary, cut old belt, or use tool to pry belt off.
5. Install new belts.	5. A) Pinched finger.	5. A) If necessary, use a tool to carefully pry new belt onto pulley.
6. Replace guard and restore power.	6. A) Mechanical hazard.	6. A) Make sure guard is reinstalled properly. Make sure people are clear of belt, and remove lock and tag.

IV. TRAINING CONVEYOR BELTS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Install idlers.	1. A) Falling from conveyor.	1. A) If there is a possibility of falling, use a safety belt and line.
2. Determine which idlers need adjusting by watching moving belt.	2. A) Mechanical hazard. Particles in eyes.	2. A) Do not touch moving belt or idlers. Wear safety glasses with side shields, or goggles.
3. Lockout and tag power switch in "off" position.	3. A) Mechanical hazard.	3. A) Properly lockout and tag power.
4. Prepare to adjust idlers by loosening the mounting bolts on several idlers upstream of the location where the belt is running to one side.	4. A) Wrench slipping - injuring hand.	4. A) Use tools in proper manner. Wear gloves.
5. Restore power to belt.	5. A) Mechanical hazard. People caught in belt.	5. A) Make sure people are clear of belt, and remove lock and tag.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Adjust idlers by tapping one end of idler support stands, with hand sledge, in the direction that will draw belt back toward center of idlers.	6. A) Flying objects (rust, dirt, etc.) B) Mechanical hazards.	A) Wear gloves and eye protection. B) Lockout and tag power whenever it is necessary to enter a guarded area, or to reach under conveyor.
7. Lockout and tag power.	7. A) Mechanical hazard. People caught in belt.	7. A) properly lockout and tag power.
8. Tighten mounting bolts on adjusted idlers.	8. A) Wrench slipping - injuring hand.	8. A) Use tools in proper manner. Wear gloves.
9. Restore power.	9. A) Person caught in conveyor.	9. A) Make sure people are clear of belt, and remove lock and tag.

V. INSPECTION OF GEAR REDUCERS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Check oil level. Add oil if needed.	1. A) Burned hand.	1. A) Wear gloves.
2. Check condition of seals. Look for oil leaks.	2. A) Mechanical hazard.	2. A) Do a visual inspection only, unless equipment power is locked-out and tagged.
3. A) Check tension of "V" belts.	3. A) Mechanical hazard	3. A) Never work on equipment unless you have locked-out power. Each person doing work must lock-out and tag. Each person must keep their key in their possession. Confirm that proper equipment was locked-out by testing start switch
4. A) Check if gear reducer is loose on shaft. Shake reducer. Repair, or report any problems.	4. A) Burned hands from hot reducer.	4. A) Wear gloves.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. A) After making any needed adjustments or repairs, replace guard and restore power.	5. A) Mechanical hazards.	5. A) Make sure guard is reinstalled properly, and remove lock and tag.

VI. INSPECTION OF HEAD AND TAIL PULLEY BEARINGS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Inspect bearings, 3-4 times weekly, while conveyor is running.	1. A) Mechanical hazard.	1. A) Leave guard on - inspect through guard. Look for orange coloration of shaft, or shaft wobbling. Look for smoke.

VII. GENERAL CONVEYOR MAINTENANCE

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Check walkways for safety hazards.	1. A) Trips and falls.	1. A) Check walkways to be sure that they are free of waste material, and that there are no weak spots. Check that steps, handrails, guardrails, and toeboards are intact, and have no damage.
2. Check belt for alignment. Inspect the lacing and splices. Make sure that all rollers are rolling, and not making noise. Check skirtboards for defects. When plant is not processing material, pull emergency cord to check that it functions correctly.	2. A) Mechanical hazards - caught in belt.	2. A) Only do visual inspections with belt running. Do not touch belt unless power is locked-out and tagged.
3. Grease head and tail pulley.	3. A) Mechanical hazards - caught in pulley.	3. A) Only grease when power is locked-out and tagged, unless pulleys are equipped with extended grease fittings.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the sand, gravel, and crushed stone industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs"

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site, where the work will be done.

The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step - explaining the job to the employee - can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom, or a quiet office, for the first part of the training. Any general theory, or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

